MELITTOBIA (*SYNTOMOSPHYRUM*) *INDICUM* (SILV.) (HYMENOPT., CHALCIDOIDEA), A PARASITE OF THE QUEENSLAND FRUIT FLY, *STRUMETA TRYONI* (FROGG.).

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Introduction.

Though the Mediterranean fruit fly, *Ceratitis capitata* Wied., was the common pest species of New South Wales in the early part of the present century, it is now only of minor importance, the dominant species being the Queensland fruit fly, *Strumeta* (*Chaetodacus*) *tryoni* (see Allman, 1939). The only commonly-occurring native parasite of this pest is *Diachasma tryoni* (Cam.), but parasitism by this species never reaches a very high percentage in cultivated fruits (Allman, 1939, p. 549).

From 1932 to 1939, the writer devoted a considerable amount of time to the attempted biological control of the Queensland fruit fly.

In the summer of 1932–33, the United States Department of Agriculture forwarded from Hawaii three shipments of parasitized puparia of the Mediterranean fruit fly, these arriving in Sydney on 10th November and 12th December, 1932, and 6th January, 1933, respectively. The puparia, which were packed either in moist sand or shredded paper in tins or glass tubes, were held at 60°F. throughout the voyage (Mason, 1934). All shipments arrived in good condition, were comparatively free of mould, and yielded large numbers of parasites. Of these, the most abundantly-occurring was *Diachasma tryoni*, the species indigenous to Australia, and which had earlier been established in Hawaii. Altogether, 7,825 adults of *D. tryoni* emerged, together with 7,290 *Tetrastichus giffardianus* Silv., 315 *Diachasma fullawayi* Silv., and 100 *Opius humilis* Silv. Immediately the first parasites emerged, breeding experiments were initiated, using loquats and later other pome and stone fruits, infested with *Strumeta tryoni*. One limited generation of *Tetrastichus giffardianus* was developed, but work with the other species gave negative results.

When it was realized that the imported material was yielding such numbers of parasites, permission was sought, and later obtained, to make direct field liberations. At intervals throughout December, 1932, and January, 1933, several thousand *Tetrastichus giffardianus* were liberated in infested orchards in the County of Cumberland, Wyong and the North Coast of New South Wales. A small liberation of *Opius humilis* was made at Carlingford, N.S.W., on 5th December, 1932, and on 17th January, 1933, a small liberation of *Diachasma fullawayi* was made at Wyong, N.S.W. However, though numerous attempts at recovery have been made, it is evident that none of these species is established in this State.

The Eulophid, *Melittobia* (*Syntomosphyrum*) *indicum*, was first discovered near Bangalore, India, in 1907 by Mr. G. Compere, then Government Entomologist of Western Australia, and was successfully transported to that State, developed in large numbers, and liberated for the control of the Mediterranean fruit fly (Newman, 1908). From a stock of the parasite obtained from Western Australia, Silvestri, in Italy in 1909, developed and liberated many thousands of the parasite in an attempt to control *Ceratitis capitata* and the olive fly, *Dacus oleae* (Silvestri, 1910). However, in spite of this extensive work, Silvestri (1914) stated that there was nothing to confirm the permanent establishment of the parasite outside India.

In New South Wales, the Queensland fruit fly attacks pome and stone fruits and the maggots in most instances soon become deeply buried and beyond the reach of parasites ovipositing from outside the fruit, even though they possess long ovipositors. As it was known that *Melittobia indicum* is not specific, and as in New South Wales

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numbers of native fruits are attacked by various species of *Chaetodacus*, and especially as it was known that *M. indicum* entered the fruit in search of its host, it was decided that an attempt to introduce the species into New South Wales was warranted.

In May, 1935, the late Mr. W. B. Gurney, then Government Entomologist, visited India in search of fruit fly parasites for shipment to New South Wales. (For details of parasitized material forwarded see Gurney, 1936.) From parasitized puparia of *Chaetodacus* spp. forwarded, there emerged four species of *Opius*, *Opius persulcatus* predominating with fewer numbers of *O. incisi* and of two new species. Extensive breeding experiments with *O. persulcatus*, and limited tests with the other three species, were undertaken in Sydney using fruits infested with *Strumeta tryoni*, but all proved negative.

Late in 1935, Gurney collected *Melittobia indicum* at Bangalore, and three batches of fly puparia parasitized by this wasp were forwarded by air to Sydney in December, 1935, but no adults emerged. A few adults did emerge from a batch of puparia brought out in the cool store of the steamer by which Gurney returned to Sydney in January, 1936, but these failed to oviposit.

On 9th October, 1937, Mr. K. K. Sastry despatched by air from Bangalore, India, a small batch of parasitized fly puparia, and these arrived in Sydney on 21st October, 1937. Flies had emerged from most of the puparia *en route*, but the few remaining puparia yielded a limited number of healthy *M. indicum*, the adult parasites emerging from 26th October to 2nd November, 1937. From these, during the ensuing seven months, eleven generations of parasites totalling more than 370,000 individuals, were developed in the insectary in Sydney (see Table 1). Apart from those required for breeding work, the parasites were liberated in large numbers throughout all infested districts of New South Wales over a period extending from 26th November, 1937, to 27th May, 1938. It is estimated that more than 205,000 were liberated in New South Wales alone. In addition, from 3rd December, 1937, to 21st April, 1938, batches of parasitized puparia were despatched to Queensland and were liberated in all the important fruit-growing areas of that State. In March and April, 1938, batches of fly puparia parasitized by *M. indicum* were despatched to Fiji. In spite of the liberation of such large numbers of the parasite throughout the entire summer period, with abundant hosts available, it has not been recovered in either New South Wales or Queensland, though in Fiji the parasite has developed in the field and batches have been sent from there to the Cook Islands, Western Samoa and Hawaii (Lever, 1938*a*, 1938*b*).

Notes on breeding methods and on the biology of *Melittobia indicum* are set out below.

Breeding Methods.

Fruits infested with *Strumeta tryoni* only were used throughout and *M. indicum* proved particularly easy to develop in large numbers in the laboratory, no special technique being required. For obtaining detailed biological data, limited numbers of infested fruits were placed over sand in small battery jars, the tops being covered with fine muslin, and the parasitized puparia being sieved out soon after pupation. For general breeding work large quantities of fruit were placed in a single layer on wire trays above a layer of sand in cages of various types in general use in the laboratory. These had sides either of glass, cloth or gauze, their size varying from one foot to two feet square.

To facilitate the entry of the parasites the fruits were either partly broken open, or in the firmer fruits, a portion was cut from one side to expose the tunnels of the fly maggots. In introducing the parasites it was found that they tended to enter the fruits on which they first alight, so that in the large cages parasites were introduced in a series of small vials, shaking a number onto each fruit in the cage. In the earlier generations, four female parasites were used for each fruit (187 apples and pears averaged 23·06 fly maggots per fruit), but later eight females per fruit were used, and gave a somewhat higher percentage of parasitism. Infested fruit was held until the fly larvae were approaching maturity.

Early in the spring infested loquats were largely used. These were later replaced by peaches and apples, which were mainly used for parasite development until late in

the summer when apples only were available. If the sand below the fruit into which the mature fly larvae make their way is either too wet or too dry, the larvae will endeavour to escape, and there is also likely to be a certain mortality. Where stone fruits were used the juice from the fruits rapidly rendered the sand very wet and care had to be exercised to remove the fruit from the cages as soon as possible after the parasites had completed oviposition. With apples, however, and especially in later generations where the variety was Granny Smith, the fly maggots did not pulp the fruit to the same extent, and very little fruit juice fell to the sand, it being necessary to keep the sand moistened with water.

The fly pupae and mature larvae were subsequently sieved from the sand, washed, spread on blotting-paper for a few minutes to dry, and then covered with very slightly moistened sandy soil and held in 6 inch by 1 inch glass vials, plugged with cotton wool. The parasitized puparia were usually held in the laboratory until after the contained parasites had reached the pupal stage, after which they were distributed.

All the fly puparia of the first, second and third generation were held in the laboratory until the adult parasites emerged and a proportion of these was subsequently liberated. The number of parasites bred in the fourth and fifth generations was assessed by holding a proportion of the puparia in the laboratory until the parasites emerged. The total adults developed in the sixth generation was calculated by multiplying the total parasitized puparia by 20, this being the average number of adults which emerged from a selected group of parasitized puparia. In assessing the adults developed in the last five generations the total parasitized puparia was multiplied by 23·41, this being the average emergence per puparium from selected groups counted in the fourth, fifth and six generations (377 parasitized fruit fly puparia yielded 8,826 adult parasites).

Usually when the parasite larvae have consumed the greater part of the fly pupa and are approaching maturity, they can be seen through the wall of the fly puparium, but occasionally when the host puparium is particularly dark in colour, the parasite larvae cannot be detected until maturity. It was found that by floating the fly puparia in water and observing them under the binocular microscope, once the parasites within had reached the mature larval stage, the parasitized puparia could be sorted with accuracy, black waste matter voided by the mature parasite larvae, and visible through the wall of the puparium, being also of assistance.

Biological Notes.

The Adult.

The adult is a comparatively small, shining, black wasp, whose size is determined somewhat by the total number of adults which develop in a single fly puparium. Heavy oviposition may produce a shortage of larval food and result in comparatively small adults. The average length of 10 females selected at random was 2·19 mm., the maximum being 2·37 mm., and the minimum 1·91 mm. The average length of 10 males similarly selected was 1·74 mm., the maximum being 1·96 mm., and the minimum 1·44 mm.

On being introduced into the breeding cages the adults feed freely on fruit juice exuding from breaks in the fruit. They are particularly easy to handle, seldom fly and do not appear to be strong fliers.

Percentage of Sexes.—Of a total of 4,257 adults of *M. indicum* emerging from batches of fly puparia selected at random in various generations from the fifth onwards, 3,126 or 73·43 per cent. were females and 1,131 or 26·57 per cent. were males.

Parthenogenesis.—A number of adult females of *M. indicum* were taken as they emerged from the fly puparium and were enclosed with fly-infested fruits. All the resultant progeny were sexed and of a total of 1,134 adults, 1,081 were males and 53 were females. There was thus a very great preponderance of males, which was the reverse of the normal sex ratio in breeding cages where parasites were allowed to mate at will. The presence of some females, however, indicates that one or more female parents may have been fertilized, and if this was so, fertilization must have occurred within the fly puparium, after the escape of the majority of the occupants. In a subsequent experiment, 10 female pupae of *M. indicum* were isolated, and on emergence of the adult parasites they were enclosed with fly-infested fruit. The sexing of their progeny gave 563 males and no females.

Longevity of Adults.—The length of life of ovipositing females is extremely short. The longest period any female was observed alive after being placed with infested fruit was three days from the time of first emergence. During the summer, adults held in 6″ × 1″ glass tubes and fed on honey and water only lived for a few days. Approximately 1,000 adults were held in such tubes in the laboratory in the autumn when temperatures were lower. These emerged on 26th May, 1938, and by 11th June, approximately three-fourths of them were dead, and thereafter some died daily, the last one dying on 22nd June, 27 days after emergence.

Oviposition.—The parasite is ready to oviposit on the day of emergence, and on being placed in breeding cages containing infested fruit, soon seeks out any breaks in the fruit surface, frequently using holes through which mature fly larvae have already left the fruit.

The parasite, on reaching a fly larva, pierces its integument with the ovipositor and lays a number of eggs within. The fly larvae become excited when the parasite is known to be present, and move rapidly through the pulpy fruit in an effort to escape. Frequently, the parasite is drawn through the fruit with the ovipositor inserted in the host larva, and has sometimes been observed in this position, motionless and apparently dead, but soon shows signs of life, withdraws the ovipositor, and crawls away apparently uninjured by the experience. On very rare occasions only, dead parasites were observed with their ovipositors firmly embedded in the integument of the host larva.

Usually the parasite penetrates the posterior segments of the host larva, but several instances were observed during the course of the work in which the parasites had pierced the host larva in segments near the head.

As under natural conditions it appeared that the main entry of the parasites was through the puncture made by the first mature fruit fly larvae leaving the fruit to pupate it would appear that usually only maturing and mature larvae are parasitized.

In the breeding cages, though up to 400 parasites were sometimes liberated in a single cage, the majority disappeared within the fruits in a few minutes, and while periodical emergence from the fruit did occur, large numbers of parasites were never again seen in the cages, the great majority eventually dying within the fruits.

In searching for host larvae, the parasites become so covered with decomposing fruit as to be almost unrecognizable, the wings, legs and antennae all becoming gummed and sticky. Periodically the parasite drags its way out to the surface of the fruit and there cleans itself thoroughly, and after resting for a few minutes again makes it way into the fruit in search of further hosts.

The fact that the fruit is already in a highly decomposed condition does not appear to affect the parasites adversely. In one instance a very satisfactory oviposition occurred in a jar of infested fruit in which fly larval activity had reduced the fruit to a slimy mass in which individual fruits could no longer be distinguished. The parasites reached their hosts by crawling down the tunnels made by the latter. Parasites will also oviposit in fly maggots taken from the fruit and placed in glass tubes. Oviposition mainly occurred during the first twenty-four hours after introduction into the breeding cages. The emergence period of adult parasites from fly larvae which were left with parasite adults for the entire life of the parasite, was very little, and at times no more protracted than in special experiments when the parasites were allowed to oviposit for two hours only. In December, 1937, a large number of parasites which had been with infested fruit for a period of 24 hours was removed and placed with a new batch of fly-infested fruit, and from fly puparia from these, only 9 adult parasites subsequently emerged.

The Egg.

The newly-deposited egg, which is invisible to the unaided eye, is elongate with rounded ends, being slightly wider towards one end. The average length at deposition is 0·16 mm., the average width being 0·038 mm. As the embryo develops, the egg increases in size, until at hatching it is twice as long, and almost three times as wide, as the newly-deposited egg. The largest egg measured just prior to hatching was 0·32 mm. in length and 0·112 mm. in width.

Incubation Period.—Under the fluctuating temperature conditions of the laboratory during mid-summer (January) the incubation period was 2½ days. At a standard

temperature of 25°C. it was approximately 3½ days and at 30°C. it was slightly less than 2 days (40–41 hours minimum).

The Larva and Larval Development.

The newly-hatched larva is greyish-green in colour with the central zone marking the stomach very slightly darker. The larva is straight-sided and cylindrical, tapering only slightly from the head backwards, there being little evidence of segmentation, and no trace of movement apart from the mouth-parts. The mouth is only very slightly ventral. The smallest larva measured with 0·29 mm. in length and 0·12 mm. in width. A few hours after hatching, the parasite larva, having fed on the blood of the host maggot in which it is lying, has increased in size, and segmentation, especially in the anterior segments, becomes much more evident.

Three larval stages were recognized, the last two resembling one another in general respects, apart from size. The mandibles of the second last stage are very pale amber in colour with one short tooth, their length averaging 0·012 mm.

The mature larva, which is greyish-green in colour, is cylindrical, only very slightly arched, and tapers towards both ends. It consists of a head and thirteen segments. The head, which is hemispherical, is somewhat translucent, as are the posterior abdominal segments. The head is narrower than the first abdominal segment and the mouth is only slightly ventral. The mandibles are minute, wide at the base with one curved tooth, amber in colour, and average 0·026 mm. in length, the chitinized tooth averaging 0·008 mm. in length. Above and below the mandibles, are a number of rounded sensillae. Very minute prominences mark the position of the antennae. The integument is smooth and free of setae. The stomach contents in some larvae are yellow and in others grey, but the stomach is partially masked by fat-body.

The size of the mature larva is variable and is largely dependent on the number of parasite larvae which have developed in one host. Where crowding occurs the food supply available for each larva is limited and the larvae at maturity are smaller. The average length of a number of mature larvae taken from various hosts was 2·17 mm., the average width being 0·69 mm. The length of the largest mature parasite larva, taken from a host in which only 10 larvae had developed, was 2·89 mm., the width being 0·82 mm. The length of the smallest mature parasite larva taken from a host in which 33 parasite larvae had developed was 1·70 mm., the width being 0·46 mm.

There is no evidence of any respiratory system in any of the larval stages, but it was noted that at maturity, the parasite larvae within the host puparium are closely enveloped in an elaborate reticulum of the tracheae of the dead host pupa.

In spite of parasitism, the fly larvae complete their development and pupate, though the shape of the puparium is sometimes abnormal and maggot-like.

Sometimes the parasite larvae have emerged from the egg before the host pupates, but often the parasite eggs are unhatched when pupation occurs. In any case, the parasite larvae after first feeding on the blood of the host, eventually on approaching maturity commence to devour the more solid and vital host tissues. Eventually the host is destroyed and the mature larvae are to be found lying within the host pupal shell.

Where the parasite larvae are not crowded, it is usual for them to arrange themselves in two even groups with the heads pointing towards the centre of the puparium, but where larger numbers are present, this same regularity of arrangement is not maintained. Occasionally one parasite larva will mature and pupate with the head pointing to the end of the puparium, with all the remaining occupants arranged in the usual regular manner.

On maturing, the parasite larva voids a quantity of dark brown or black waste matter, which can usually be seen through the wall of the parasitized puparium, and which makes the two ends of the latter much darker.

Emergence of Adults.

Parasite adults emerge by eating out a somewhat irregular emergence hole in the surface of the puparium. Sometimes these holes are large and gaping. Of thirty

puparia selected at random, from which adults of *M. indicum* had emerged, six only had one emergence hole, eleven had two, five had three, four had four, three had five, and one had six.

As a rule adult flies commence to emerge several days before the adult parasites begin emerging from parasitized fly puparia from the same batch.

In various generations fourteen batches of parasites were left with infested fruit until the parasites died, and daily records of the emergence of their progeny were kept. Altogether a total of 9,791 adults of *M. indicum* emerged. Of these, five batches had an emergence period of three days, two had an emergence period of four days, five had an emergence period of five days, one had an emergence period of six days, and one had an emergence period of seven days. Of the total of 9,791 adults, however, 7,679 or 78·43 per cent., emerged during the first three days of the emergence period.

Length of Life-Cycle.

The minimum length of the life-cycle under the fluctuating temperature conditions of the laboratory in the various generations is set out in Table 1. It will be noted that the first generation had a minimum life-cycle of 24 days, but the minimum length of life-cycle decreased progressively as the summer season advanced, the minimum being 15 days in the third and fourth generations. With the approach of autumn and consequently lowered temperatures, the minimum length of life-cycle again increased, being 22 days in the tenth generation and 32–33 days in the eleventh generation.

TABLE 1.

Details of Laboratory Development of Melittobia indicum.

Generation.	Date of First Exposure of Fruit Fly Larvae.	Date of First Emergence of Adults of *M. indicum*.	Total Fly Larvae Parasitized.	Minimum Life Cycle of *M. indicum* in Days.	Total Adults of *M. indicum* Emerging.	Remarks.
First	26.x.37*	19.xi.37	Not counted.	24	245	Adult parasites counted.
Second	24.xi.37	13.xii.37		19	707	
Third	13.xii.37	28.xii.37		15	1,500	
Fourth	28.xii.37	12.i.38		15	17,500	Estimate based on emergence of adults of *M. indicum* from a proportion of the puparia held in Sydney.
Fifth	13.i.38	31.i.38		18	74,000	
Sixth	31.i.38	16.ii.38		16	63,600	
Seventh	16.ii.38	4.iii.38	3,453	16	80,800	Total adults estimated on the basis of 23·41 per puparium.
Eighth	8.iii.38	25.iii.38	1,286	17	30,000	
Ninth	25.iii.38	11.iv.38	1,609	17	37,700	
Tenth	11.iv.38	3.v.38	2,425	22	56,800	
Eleventh	3.v.38	4 or 5.vi.38†	312	32/33	7,300	

Total parasites developed: 370,152.

* First adults of *M. indicum* emerged from fruit fly puparia from India on 26th October, 1937, and the last on 2nd November, 1937.

† Last adult of this generation emerged on 20th June, 1938.

Period Spent in Various Stages of the Life-Cycle.

In the fourth generation an experiment was carried out to ascertain the period of time required by the parasite to complete the various stages in the life-cycle. Parasites were allowed to oviposit for a period of three hours and the maggots were then removed from the fruit, and held in the laboratory and periodically thereafter parasitized fly larvae or puparia were dissected and the stages of *M. indicum* noted. The results are set out in Table 2.

It will be seen that the total life-cycle under these conditions ranged from just less than 16 days to just less than 18 days. Considering the minimum life-cycle of 16 days, the incubation period was approximately 2½ days, the larval and prepupal period 7 days, and the pupal period 6½ days, the latter period also including the time required for the adults to eat their way out of the host. In this experiment, though all the eggs were

laid within three hours, there was a variation of as much as two days in the emergence of adults.

TABLE 2.

Observations on the Developmental Period of Various Stages of Melittobia indicum *under Laboratory Conditions.*

Date of Observation.	Time of Observation.	Stages of *M. indicum* Present.	Date of Observation.	Time of Observation.	Stages of *M. indicum* Present.
18.i.38	2.5 p.m.	Eggs just laid.	25.i.38	9 a.m.	Prepupae.
19.i.38	4 p.m.	All eggs.	26.i.38	5 p.m.	Prepupae.
20.i.38	11 a.m.	Newly-hatched larvae and a few eggs.	27.i.38	9 a.m.	Unpigmented pupae.
			3.ii.38	11 a.m.	58 adults emerged.
22.i.38	2 p.m.	Maturing larvae.	4.ii.38	2 p.m.	94 adults emerged.
24.i.38	9 a.m.	Mature larvae.	5.ii.38	11 a.m.	52 adults emerged.

Number of Adults Emerging from Each Fly Puparium.

In tests in which individual females were confined with numbers of maggots the number of adult parasites emerging from each of 95 fly puparia ranged from 2 up to 36, the average being 17·35. In another experiment 187 *M. indicum* emerged from 6 puparia giving an average of 31·17 per puparium, and from one puparium in this experiment 37 adults emerged. In the fourth generation a total of 5,084 parasites emerged from 208 puparia, the average per puparium being 24·44. Altogether, in counts of parasites emerging from batches of fly puparia taken from the ordinary breeding cages in the fourth, fifth and six generations, 8,826 *M. indicum* emerged from 377 fly puparia, the average per puparium being 23·41. In one instance 45 mature larvae and pupae of *M. indicum* were found in 1 fly puparium, and in another 39.

In every instance recorded above there were numbers of fly maggots available which remained unparasitized. The average yield of parasites per puparium in the breeding cages, where large numbers of parasites were present, was much higher than the average when single females only were used, and it is probable that in the former circumstances superparasitism occurred.

Total Progeny of Individual Females.

Sixteen *M. indicum* females were enclosed singly with jars of infested fruit. Subsequently the parasitized puparia were isolated, and the total progeny of each female parasite and from each fly puparium is set out in Table 3. It will be seen that

TABLE 3.

Total Progeny of Individual Females of Melittobia indicum.

Female Number.	Host Larvae in Fruit.	Host Larvae Parasitized.	Adults of *M. indicum* Emerging from Each Fruit Fly Puparium.										Total Progeny.
1	63	10	15	18	11	17	18	18	15	11	2	15	—	140
2	49	7	21	17	19	14	21	17	19	—	—	—	—	128
3	62	10	14	19	10	14	23	17	12	16	20	25	—	170
4	42	2	22	31	—	—	—	—	—	—	—	—	—	53
5	43	1	19	—	—	—	—	—	—	—	—	—	—	19
6	26	3	16	17	23	—	—	—	—	—	—	—	—	56
7	61	11	9	17	16	15	16	11	21	20	18	15	14	172
8	40	10	13	14	13	20	14	10	15	13	16	23	—	151
9	28	8	16	17	11	5	8	11	15	14	—	—	—	97
10	17	4	24	25	5	36	—	—	—	—	—	—	—	90
11	44	4	19	15	12	14	—	—	—	—	—	—	—	60
12	21	5	21	20	24	23	20	—	—	—	—	—	—	108
13	30	8	13	16	16	26	18	19	15	15	—	—	—	138
14	16	2	21	27	—	—	—	—	—	—	—	—	—	48
15	19	6	12	14	29	27	17	15	—	—	—	—	—	114
16	29	4	23	28	27	26	—	—	—	—	—	—	—	104

Average number of progeny per female : 103 ; maximum, 172 ; minimum, 19. Average progeny per pupa : 17·35 ; maximum, 36 ; minimum, 2. Average number of larvae attacked by each parasite : 5·94 ; maximum, 11 ; minimum, 1.

the total progeny ranged from 19 up to 172 for each female, the average being 103, and that the number of puparia attacked by each of these sixteen parasites ranged from a maximum of 11 to a minimum of 1, the average being 5·94.

Percentage of Parasitism.

In a series of experiments (Table 4) various concentrations of parasites were used in breeding cages, and subsequently the total parasitized and unparasitized fly larvae were counted. The percentage of parasitism thus obtained was very variable, and while in several of these experiments it reached a very high figure, even in experiment No. 3, where almost two female parasites were available for each fly larva, it did not reach 100 per cent. The breaking, or cutting, of the fruit to facilitate parasite entry and the subsequent activities of the parasites therein, disturbed the larvae, and, as many of the latter were mature, they left the fruit promptly and escaped parasitism.

Parasitism obtained in the laboratory cannot be considered as a reliable indicator of what may take place in the field. On the other hand, it appears that the main entry of the adult parasite even under field conditions is through openings made by the first fly larvae leaving the fruit to pupate, and some fly larvae will always thus escape parasitism. The fact that by far the greatest parasite oviposition occurs during the first twenty-four hours, is obviously a great advantage when it is remembered that the host larvae are maturing or mature at the time the parasites enter the fruit.

TABLE 4.

Percentage of Strumeta tryoni *Parasitized by* M. indicum *in the Laboratory.*

Experiment Number.	Female Parasites Used.	Fruit Fly Larvae Present.	Fly Larvae Parasitized.	Percentage of Parasitism.
1	77	102	66	64·71
2	80	94	88	93·62
3	520	267	222	83·15
4	100	50	39	78·00
5	313	1,370	898	65·55
6	120	386	119	30·83
7	120	486	270	55·55

Details of Seasonal Breeding.

In Table 1 are set out the detailed records of the numbers of adult parasites developed in the eleven generations, in the laboratory in Sydney. It will be seen that altogether 370,152 adults of *Melittobia indicum* were developed. The minimum life-cycle varied from 15 to 33 days in the various generations, and adults of *M. indicum* were emerging in the laboratory from 19th November, 1937, until 20th June, 1938, which is the first month of winter. The temperatures prevailing in September and October in New South Wales would easily enable *M. indicum* to complete one generation prior to the end of October, so that under New South Wales conditions *M. indicum* could pass through twelve generations per annum.

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